



# **Bibliography of Literature Pertaining to Long Valley Caldera and Associated Volcanic Fields**

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## Introduction

On May 25-27, 1980, the Long Valley caldera was rocked by four  $M = 6$  earthquakes. This seismicity heralded the onset of a wave of activity within the caldera that has continued through the present time. Unrest has taken the form of seismic swarms, uplift of the resurgent dome, and areas of vegetation killed by increased  $\text{CO}_2$  emissions, all interpreted as resulting from magma injected to different levels beneath the caldera as well as [in] beneath Mammoth Mountain along the southwest rim of the caldera. Continuing economic development in the Mammoth Lakes area has swelled the local population, increasing the risk to people and property if an eruption were to occur. The U.S. Geological Survey has been monitoring geophysical activity in the Long Valley area since the mid-1970s and continues to monitor the unrest in real time with a sophisticated network of geophysical sensors in order to track developments in the unrest. Hazards information obtained by this monitoring is provided to local, state and federal officials, and the public through the Long Valley Observatory.

The Long Valley caldera area was also scientifically important before the onset of the current unrest. Lying at the eastern foot of the Sierra Nevada, the deposits from this active volcanic system have provided fertile ground for research into Neogene tectonics, Quaternary geology and geomorphology, regional stratigraphy, and volcanology. In the early 1970's, intensive studies of the area began through the USGS Geothermal Investigations Program owing to the presence of a large young silicic volcanic system (Muffler and Williams, 1976). The paroxysmal eruption of Long Valley caldera, ca. 760 ka, produced the Bishop Tuff and associated Bishop ash (Gilbert, 1938; Bailey and others, 1976; Hildreth, 1979). The Bishop Tuff is a well preserved ignimbrite deposit that has continued to provide new and developing insights into the dynamics of ignimbrite forming eruptions (e.g. Wilson and Hildreth, 2003). Another extremely important aspect of the Bishop Tuff is that it is the oldest known normally magnetized unit of the Brunhes Chron. Thus, the age of the Bishop Tuff is used to define the beginning of the Brunhes Chron and helps constrain the Brunhes-Matuyama boundary (Izett and Obradovich, 1994). The Bishop ash was dispersed as far east as Nebraska, Kansas, and Texas, and provides an important tephrostratigraphic marker throughout the western United States (Ward et al., 1993; Izett, 1982).

The obsidian domes of both the Mono and Inyo Craters, which were produced by rhyolitic eruptions in the last 40,000 years, have been well studied (Bursik and others, 2003), including extensive scientific drilling through the domes (Eichelberger, 1989). Exploratory drilling to a depth of 3 km on the resurgent dome and subsequent instrumentation of the Long Valley Exploratory Well (LVEW) has led to a number of important new insights (Hill and others, 1998; Sorey and others, 2000; Sorey and others 2003). Scientific drilling also has been done within the Casa Diablo geothermal field (Smith and others, 1977). Aside from drilling, the Casa Diablo geothermal field was developed and is currently feeding 40 megawatts of power into the Southern California Edison grid (Duffield and others, 1994).

Studies in all of the above mentioned fields have contributed to the extensive scientific literature published on the Long Valley caldera region. Although the majority of scientific literature on Long Valley has been produced since 1970, a significant amount

of historical literature extends back to the late 1800's. The purpose of this bibliography is to compile references pertaining to the Long Valley region from all time periods and all earth science fields into one single listing, thus providing an easily accessible guide to published literature for current and future researchers.

### **Methods**

We include references in this bibliography if they are directly applicable to the Long Valley caldera and its recent geophysical unrest, Mono Craters, Inyo Craters, Mono Lake Volcanic Field, and the deposits from these volcanoes, or if they contained regional geological, biological, or meteorological information that would be important to a researcher investigating aspects of the geology and geophysics of the area. Because of the relatively small number of references prior to 1940, we took a broader view of relevance within the older literature. In contrast, we took a more restrictive view of relevancy for the post-1940 references.

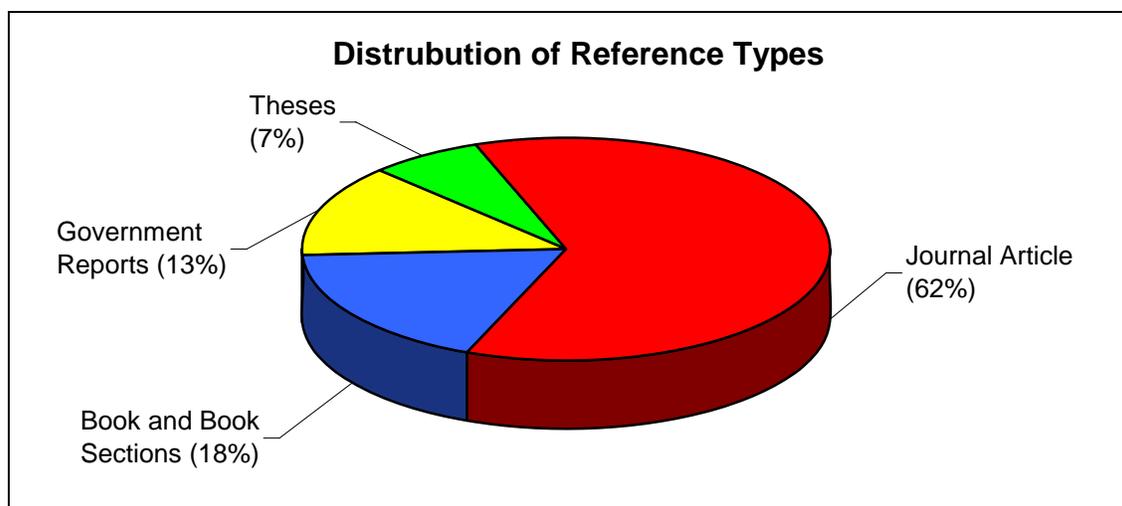
In this version 1.1, references were researched primarily using the database resource GeoRef as well as supplemental library searches of the most current literature. Meeting abstracts are not included in the main bibliography of version 1.1. However, abstracts dating through the year 1999 are included in version 1.0. These abstracts are still available as part of the original version and have been included in this report separately. Version 1.1 also now includes biological references as related to the geology of the Long Valley Caldera region. These newly added references have biology listed as one of the reference keywords.

### **Formatted Bibliography**

The Long Valley bibliography is available as a standard alphabetical listing of publications in both Adobe Portable Document Format (PDF) and as a library in the computer program EndNote©. The entire bibliography may be printed from either Adobe Acrobat viewer or the EndNote© program. EndNote© provides a full search utility of references and Acrobat's simple search utility can be used to find specific words or phrases.

### **Statistics**

This bibliography contains a total of 1056 references, which we classify into four categories: books and book sections, theses, journal articles, and governmental reports (Fig. 1). We estimate that this bibliography is complete through April 2004. However, since references mainly were researched by using Georef, references not listed in the database may not have been included.



**Figure 1.** Graph showing the distribution of references by type.

The largest reference group is journal articles with 642 total references, or 62% of the total bibliography. This is not surprising, as the same trend has been found with literature pertaining to the Hawaiian Islands (Wright and Takahashi, 1998).

Book and book sections are the second largest group and comprise 18% of the bibliography with 195 references. This category includes portions of Geological Society of America Special Papers as well as chapters published in books about hazard management and techniques for volcano monitoring (e.g., Sheridan, 1968; Andrews, 1968). Proceedings from meetings are also included in this category (e.g., Liddicoat and Bailey, 1989), and generally have been distinguished from abstracts by being over one page in length.

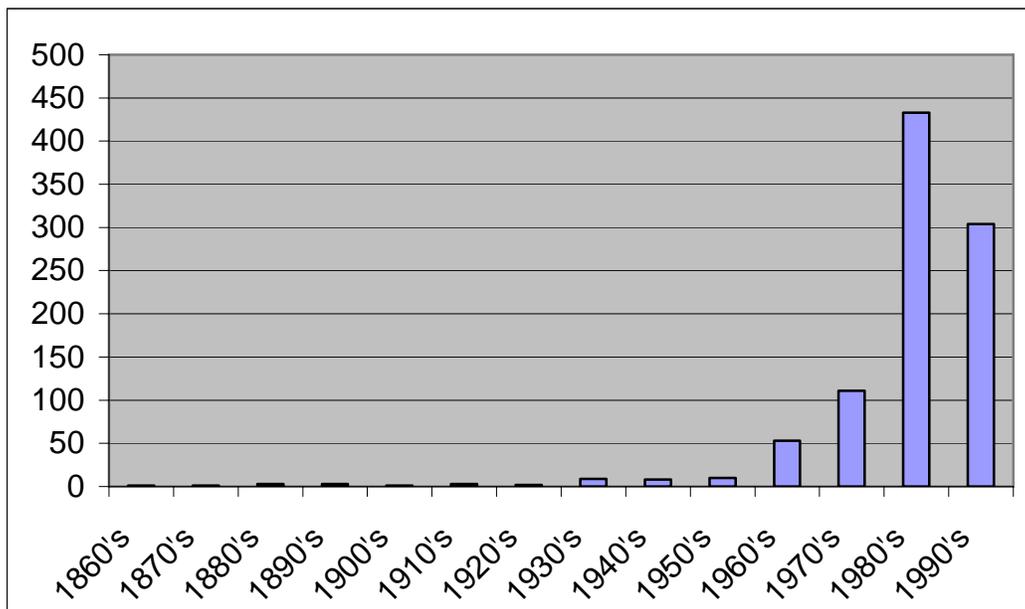
Government reports are third in number with 140 references or 13% of the total. This category includes all State and Federal documents such as U.S. Geological Survey Professional Papers and Open-File Reports. Exceptions to this apply when a governmental agency has published meeting abstracts. In this case, these references have not been included. Another exception is the field guide to the Long Valley area by Bailey and others (1989) published in New Mexico Bureau of Mines and Mineral Resources Memoir 47 that is included in the book and book section category. Although not a government report, a report by the Seismological Laboratory at the University of Nevada, Reno has been included in this section.

The final and smallest category is theses, making up 7% of the bibliography. A total of 76 theses including 32 Master's and 44 Ph.D. theses have been written on Long Valley subject matter with topics varying from geological mapping (e.g., Dunn, 1951), to volcanic geology and petrology (e.g., Bailey, 1978), to the seismic structure of the area (e.g., Mayeda, 1991).

The number of references for each discipline keyword varies from seismology with 258 references to biology with six references. The other disciplines are fairly linearly distributed between these two end members.

## Discussion

The graph of number of references published per decade (Fig. 2) shows that the bulk of the literature on the Long Valley area has been published since 1970. However, several interesting patterns are apparent in the early literature on the area. The first geological exploration of the region occurred in the 1860's (Whitney, 1865). The region's volcanic nature has been recognized since at least the 1870's, and many of the early references published from 1870 through 1900 are related to volcanic features such as the obsidian domes (e.g., Le Conte, 1879). From 1900 until 1920, however, the water resources of the region took the forefront of the published research (e.g., Lee, 1912). Volcanic and Pleistocene geology returned to prominence through the 1920's to 1940's (e.g., Gilbert, 1938; Kesseli, 1948). In the 1950's, general geology was emphasized, and geologic maps for both the Casa Diablo and Bishop 15-minute quadrangles were published (Bateman, 1957; Rinehart and Ross, 1957). Also, results from the first geophysical survey of the region were reported in the 1950's by Pakiser and others (1958).



**Figure 2.** Graph of the distribution of references published per decade from 1880 through the 1990's showing the increase in published literature since the 1960's. This increasing trend reflects the intensity of the unrest within the region.

The rising trend in the number and variety of publications began in the 1960's, principally due to an increasing interest in the Casa Diablo geothermal area. Initial exploratory geothermal drilling was carried out during the 1960's, followed by more intensive drilling and study in the 1970's. In 1976 a Journal of Geophysical Research volume was dedicated to geothermal research in Long Valley, and multiple U.S. Geological Survey Open-File Reports were published on the geothermal exploration (Muffler and Williams, 1976, and refs. within).

The number of published references jumped significantly in the 1980's. This abrupt increase is related to the onset of unrest within the caldera and implementation of the USGS effort to monitor the unrest both as a basis for understanding the nature of the unrest and its implications for providing advance warning of an impending eruption. The papers cover a wide range of topics such as ground deformation (e.g., Castle and others, 1984), seismicity (e.g., Ryall and Ryall, 1983), and the consequences of a large scale eruption (e.g., Miller and others, 1982). They include two special issues in the Journal of Geophysical Research devoted to Long Valley caldera (Hill and others, 1985; Goldstein and Stein, 1988) as well as a more recent special issue in the Journal of Volcanology and Geothermal Research (Sorey, 2003).

The publication rate during the 1990's and early 2000's has dropped off slightly from the 1980's level, although the rate remained high compared to pre-1980 levels. The elevated number of publications reflects the continuing unrest within the caldera, the continuous stream of real-time geophysical data, and the emergence of a new volcanic phenomenon during the 1990's. Recognition of "tree-kill" areas caused by magmatic CO<sub>2</sub> effusing from the ground in the vicinity of Mammoth Mountain, for example, spurred a sequence of publications (e.g., Farrar and others, 1995; Gerlach and others, 1999). Also, new forms of monitoring, such as the use of the Global Positioning System, began to be utilized within the caldera during this decade adding to the literature (e.g., Marshall and others, 1997; Newman and others, 2001; Langbein, 2003). Publication trends seen in the 2000's show that they will most likely match the number of publications produced in the 1990's.

Persons wishing to develop an understanding of the geological history and ongoing unrest of the Long Valley caldera and associated volcanic fields, and who are new to the subject, may find the sheer volume of literature on the area to be daunting. An overview of the subject matter can be gained by reading the following papers: Bailey and others, 1976; Bailey, 1989; Bailey and Hill, 1990; Hermance, 1983; Hill and others, 1985; Hill and others, 2002 (appendix A); Langbein and others, 1993; Rundle and Hill, 1988; Ryall and Ryall, 1981; Sorey and others, 1991; and Sorey and others, 2003.

## **Conclusions**

This bibliography comprises a total of 1056 references on Long Valley caldera and vicinity. We have tried to be as complete as possible in our coverage of the geological and geophysical literature pertaining to the volcanic system (through April 2004). As time and resources permit, this database will be up-dated with references that may have been omitted and kept up to date with newly published literature.

## **EndNote© Reference Database**

This bibliography is maintained using the EndNote© program. Within this program the bibliography is searchable by author, title, year, journal, or discipline keyword. In more recent references (dating from 1998- April 2004), some journal article abstracts have been included in the EndNote© reference records as they were electronically available. A total of 20 discipline keywords are used to indicate the content of the references (Table 1). More than one keyword may be applied to a single reference. For example, references on tomography of the Long Valley area are listed under both the "seismology" and

"geophysics" keywords as the subject pertains to both disciplines. Similarly, references on the Bishop ash are listed under both the "stratigraphy" and "Bishop Tuff" keywords. The keywords are relatively self-explanatory with the exception of "descriptive". The "descriptive" keyword applies to field guides, descriptions of eruption mechanisms, and general references that do not specifically fit into any other category. Very specific searches of the title field can be made by employing a single word or phrase and may be the most useful search strategy. For example, a search for titles that include the word "Holocene" returns 10 references with Holocene in the title. For those who do not have EndNote®, a trial version is available at <http://www.endnote.com>.

**Table 1.** List of discipline keywords and the total number of references covered by the keyword.

Discipline Keyword	Total Number of References
Seismology	258
Geochemistry	187
Geophysics	175
Geothermal	154
Descriptive	147
Petrology	134
Geology	134
Hydrology	113
Bishop Tuff	108
Deformation	87
Geomorphology	67
Geochronology	51
Drilling	43
Hazards	39
Tectonics	32
Monitoring	24
Remote Sensing	17
Modeling	15
Atmosphere	10
Biology	6

## References

### EndNote© program and data base

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For questions about the content of this Open-File Report, contact [J.W. Ewert](mailto:jjewert@usgs.gov) ([jjewert@usgs.gov](mailto:jjewert@usgs.gov)).

### Version 1.0

The older version of the bibliography has been archived at <http://pubs.usgs.gov/of/2000/of00-221/version1/>

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